



Review Article

Update of the nutritional situation in the Republic of Sudan

Howeida Abusalih^{1*}, Zeinab Abu Sabeib²¹ Princess Nourah Bint Abdulrahman University. College of Health Sciences and Rehabilitation, KSA² Princess Nourah Bint Abdulrahman University. College of Nursing, KSA

Abstract

Background: Sudan is situated in the northeastern part of Africa. The population of the country is approximately 43 million, spread over 1.88 million square kilometers. Although Sudan has great resources, most of the population suffers from poverty and food deficiency because of the conflicts in the different parts of the country. The suffering was augmented by climatic drought and floods which resulted in food insecurity. The population's internal displacement is disadvantageous regarding access to health services and is consequently more vulnerable to diseases and malnutrition. In Sudan, thirty-three percent of the population suffered from food deprivation according to the national survey of 2010. The prevalence of undernourishment was 31% and 34 % percent for urban and rural populations respectively. Furthermore, based on WHO epidemiologic criteria, the prevalence of stunting and wasting are classified as profound, 38.2%, for stunting which is more than the average of the developing countries (25%), wasting defined as low weight for height also has a higher prevalence in under-five in Sudan comparing it to the developing countries' average which is 16.8% and 8.9% respectively. Although recent national survey data are lacking, it is evident that micronutrient deficiencies are a major public health concern from the sporadic studies' findings. Notwithstanding these challenges, the government and the Federal Ministry of Health, move along to make progress towards nutrition and food security, some supplementation campaigns have been conducted but coverage of the population is still low. Sudan is one of the 61 countries that leading a global movement to end up malnutrition in all its forms.

Keywords: Sudan, deficiencies, food, micronutrient, mortality, insecurity.

Received: August 08, 2020 / Accepted: November 04, 2020 / Published: November 15, 2020

1 Introduction

Sudan is the third largest northeastern African country spreading over 1.88 million square kilometers, bordering the Red Sea Central African Republic, Chad, Egypt, Eritrea, Ethiopia, Libya and South Sudan. The northern part of the country is an extension of the Sahara desert while the central part is a dry savannah area and the southern part has a tropical forest climate. Total population estimation around 43 million according to central intelligence date of the United States¹. The population's distribution shows that 33.2% live in an urban setting while 8% are nomads, almost 2% of the population are internally displaced. Life expectancy at birth reached 63/67 for males/females respectively, and the annual death rate is 16.7%. The population pyramid showed that nearly 45% of the total estimated population were below 15 years of age and 15% below 5 years of age, while those aged 65 years and over represent only 4% of the population. The average household size is 5-6 persons, while the annual population growth rate of 2.6% and the total fertility rate is 5.9^{2,3}. Although the growth domestic product (GDP) grew from 9.9 billion USD in 1980 to 57.9 billion USD in 2008 but it has no accompanied human development and poverty remains an issue. Lack of transport infrastructure is adding to the problem. The economic situation was worsened by the loss of about 80% of its oil resources and almost half of the country's revenue following the separation of

South Sudan state now known as the Republic of South Sudan in 2011 resulting in a reduction of growth rate of gross domestic products (GDP) from 7.8% in 2008 to 3.1% in 2014. The great disparities between urban and rural development led to increasing the contribution of urban informal sector to Sudan's GDP by more than 60%, and this was evident by the concentration of investments and services in and around Khartoum state. These disparities encouraged rural-urban migration that weakens the agricultural productivity, which historically remained as the main source of income and employment in Sudan, hiring over 80% of Sudanese and making up a third of the economic sector. In the agricultural sector, the government has tried to diversify its cash crops; however, cotton and gum Arabic remain its major agricultural exports. When the problems of irrigation and transportation remain the greatest constraints to a more dynamic agricultural economy. Livestock production also has vast potential, and many animals, particularly camels and sheep, are exported to nearby countries. The country is still gifted with rich natural resources, including natural gas, gold, silver, chromite, asbestos, manganese, gypsum, mica, zinc, iron, lead, uranium, copper, kaolin, cobalt, granite, nickel, tin and aluminum. This information on the natural and economic resources resulted in a poverty rate of 46.5%, per capita income of 1270 USD and

Human Development Index of 0.414^{4,5}. The health system in Sudan is composed of the Federal and State Ministries, military medical services, police, universities, and private sector. The public health governance was distributed between the federal government, states and the localities as stated in the Interim Constitution (2005) and the Local Government Act (2003). The health service delivery for the public sector is organized at three levels: primary, secondary and tertiary based on the endorsed health systems standards following a consultative process involving states. The National Nutrition Directorate (NND), established in the Primary Health Care General Directorate, is the body through which the Federal Ministry of Health ensures the provision of high-quality nutrition interventions, by defining technical standards for health and nutrition work, facilitating inter-sectoral coordination, as well as monitoring the overall quality of nutrition services⁶. Sudan is one of the 61 countries that leading a global movement to end up malnutrition in its all forms. On 14 October 2015, the Republic of Sudan joined the Scaling Up Nutrition (SUN) Movement investment with a letter of commitment from the Federal Minister of Health. While considerable progress had been made in some areas including fortification and supplementation, more needed to be done to reduce chronic undernutrition, anemia, and low birth weight. Sudan instituted a strong mechanism for scaling up nutrition consist of establishing a multi-sectoral platform (MSP) for nutrition which includes the Higher Council of Food Security and Nutrition which links states ministries of health with the National Nutrition Program Office (NNP) of the Ministry of Health. Also, formulation of National Nutrition Committee (NNC) in order to engage with stakeholders including the private sector, civil society, UN agencies, development partners and academia. In addition to that, Sudan has developed advocacy tools and a decentralization plan to districts, complemented community-level coordination structures. The reports of 2019 showed a success in bringing people together into a shared space for action by establishing the SUN Academia and Research Network and the subsequent successful nomination of the Faculty of Medicine at the Khartoum University as a convener marks another step towards a fully inclusive Multi-Stakeholder Platform (MSP). Although the current nutrition interventions focus on the treatment of acute malnutrition there is an ongoing and gradual shift towards longer term activities, in particular the prevention of stunting. The National Multi-Sector Nutrition Plan (NMNP), including mapping of all nutrition interventions, is underway. In terms of ensuring a coherent policy and legal framework, nutrition is emphasized within the current NHSS 2014-2018 as part of the basic package of Public Health Care service. Nutrition is among the core programs addressed through the Maternal and Child Health Acceleration Plan. Guidelines and protocols have been developed for Community Management of Acute Malnutrition, the hospital management of Severe Acute Malnutrition and Infant and Young Child Feeding to improve service provision⁷.

2 Dietary intake

It is important to understand dietary patterns as it plays a vital role in reducing the number of people suffering from malnutrition, overweight or obesity and micronutrient deficiencies. The global trends in diets for all countries between 1961 and 2011 showed that the prevalence of inadequate intakes of micronutrients has improved except for sub-Saharan Africa where there is a slight reduction in the intake⁸. In Sudan thirty-three percent of the population suffered from food deprivation according to Sudan National Baseline Household Survey data. The prevalence of undernourishment was 31% and 34 % percent for urban and rural populations, respectively as shown from Sudan household survey in 2010⁹. According to a food security assessment in Sudan in 2009, the average Sudan national's daily dietary energy consumption (DEC) was 2180 Kcal per person. Rural and urban areas had similar daily DEC levels of 2140 and 2270 daily Kcal per person, respectively. The depth of hunger, which refers to the amount of daily dietary energy consumption per person required by the undernourished population to reach the minimum dietary energy requirement (MDER), was 344 Kcal at the national level and 343 and 344 Kcal in urban and rural areas, respectively. This amount of DEC expressed in food quantity is about 100 grams of daily food grains per person which is equivalent to about 37 kg of yearly food grain consumption per person, ignoring possible food losses after food acquisition. The percentage of food in total household consumption, food ratio (FR), was 61.4 percent at the national level, lower in urban areas, 56.4 percent, than in rural areas, 65.7 percent. The contribution of macronutrients (carbohydrate, fat and protein) to DEC ranked carbohydrate as the highest source of energy (65.7 percent) followed by fat (21.9 percent) and then protein (12.4 percent)¹⁰. These contributions to total energy were in line with the WHO/FAO guidelines for a balanced diet by energy-yielding macronutrients¹¹. The food and nutrition Security Assessment in Sudan: Analysis of 2009 National Baseline Household Survey revealed that the percentage of DEC from purchases at the national level for the whole country was 80.9 percent, distributed as 91.8 percent in urban areas and 75.2 percent in rural areas. In terms of food sources for DEC from own production was 7.6 percent nationwide, 1.4 percent in the urban areas and 10.7 percent in rural. The highest contributions to DEC measured by the Coefficient of Variation (CV) of DEC from own production which was almost identical to urban and rural populations due to similar income in a percentage of 31.2 and 32.2 percent respectively; however, it was higher in female than in male-headed households, 35.1 and 29.6 percent, respectively¹⁰.

3 Micronutrient deficiencies

The deficiencies of essential micronutrients are outlined below.

3.1 Iron deficiency

Few data is available on iron deficiency in Sudan. The prevalence of anemia, during the crisis-affected population in Darfur, was 55% according to emergency food security and nutrition assessment in 2005¹². The prevalence is almost the same in pregnant women as extracted in meta-analysis in 2018 of 16 cross-sectional studies included a total of 15,688 that showed a pooled prevalence of anemia of 53.0% (95%, CI = 45.9–60.1)¹³.

3.2 Vitamin-A deficiency

Although vitamin A deficiency (VAD) is estimated to be endemic in many countries, little data on its prevalence are available for many regions of Sudan. According to WHO latest statistics survey in six states showed a prevalence of exophthalmia of 3.20 % as of 1996 children under five years¹⁴. The prevalence of Vitamin A deficiency reached 44% in children and 22% in mothers as shown in the nutrition country profile of the year 2000¹².

3.3 Vitamin D deficiency

A recent cross-sectional study, conducted by Husain *et al.* in 2019 in health centers in Khartoum, Sudan, showed that 82.6% of women were deficient in vitamin D. This may signify that sunshine alone is not a sufficient source for vitamin D in the tropics¹⁵.

3.4 Zinc deficiency

Zinc deficiency, particularly in developing countries is highly frequent, where the dominant diet depends on cereals and it is low in protein. The deficiency of zinc can have negative health impacts, affecting many body systems¹⁶, and is an essential nutrient for growth; it reduces mental capacity; and increase the prevalence of maternal, neonatal and child complications¹⁷. A case-control study was conducted by Abass *et al.* in 2014 in Medani Hospital in Sudan revealed that the maternal zinc level, was lower in LBW newborns than in those with normal weight¹⁸.

3.5 Iodine deficiency

Although there is no national recent survey data about micronutrient deficiencies in Sudan, it is evident that they resemble a major public health problem; especially in children and pregnant women, as evident by sporadic studies in different parts of the country. Deficiencies of iodine and iron if not treated will result in significant adverse and serious health concerns; during fetal stage or early infancy, can cause motor and mental retardation¹⁹. The Federal Ministry of Health in 1999 declared that 22% of the Sudanese population have iodine deficiency, the number of children born with iodine deficiency each year is 242,400, among them, the cretins are estimated to be 7,000, and those who will suffer from severe mental retardation are 24,000. The neonates, who will grow up with a

mild degree of intellectual deficit, are estimated to be 210,000. Among every ten children of school-going age, two children may suffer from iodine deficiency, most of them do not have visible signs and symptoms like goiter²⁰.

Table 1: Prevalence of Iron, Iodine Vitamin A, and Zinc deficiencies in Sudan

Micronutrients deficiency	Prevalence (%)
Iron deficiency anemia	85
Iodine deficiency disorders	22
Vitamin A deficiency in children	27.8
Zinc deficiency	7.4
Vitamin D deficiency	82.6

Data source for iron deficiency anemia from WFP Sudan 2005¹², iodine deficiency from Zimmermann *et al.* (2004)¹⁹, Vitamin A deficiency from WHO 2000¹⁴, and Vitamin D deficiency from Husain *et al.* 2019¹⁵.

4 NCDs

The most prevalent non-communicable diseases in Sudan include, hypertension, ischemic heart disease, cancers, diabetes mellitus, asthma, renal disease, general injuries and road traffic accidents, injuries and mental health disorders. These selected diseases accounted for 41% of all deaths in 2005²¹. Cardiovascular disease (CVD) is one of the major causes of mortality, disability and morbidity. In Sudan, the tetrad of hypertension, rheumatic heart disease, ischemic heart disease, and cardiomyopathy constitute the majority of CVD in a percentage of around 80% of cases. The Sudan House Hold Survey conducted in 2010 showed a prevalence of 2.5% self-reported heart disease. Hypertension had a prevalence of 20.1% in this survey⁹. In 2016, the stepwise survey used to measure the risk factors of non-communicable diseases NCDs, showed that 20.4%, 28.3% and 10% of the Sudanese population suffer from hypertension, overweight or obesity respectively with the percentage being much higher in women (35.6%) than men (22.6%). Overall (17%) of urban respondents were obese as compared to (6.2%) of rural participants with the prevalence being significantly higher (25.0%) among urban females compared with rural females (8.6%) which indicates a higher risk of NCDs and their complications.

The biochemical measurements showed an overall prevalence of impaired fasting glycemia of 3.4% while the prevalence of raised fasting blood glucose was 6%. Furthermore, there was a marked difference between urban (8.7%) and rural (4.4%) and the difference was more marked when comparing urban females (11.2%) to rural ones (4.7%). To complete the picture of metabolic syndrome among the Sudanese population, the mean total blood raised cholesterol, including those currently on medication was 13.8% and the percentage of CVD risk for aged 40-69 years with a 10-year $\geq 30\%$, or with existing CVD was 3.5%²².

A Five-year Survey of Cancer Prevalence in Sudan extracted from Radiation and Isotope Centre in Khartoum (RICK) which covers approximately 80% of patients with cancer in Sudan for the period 2009-2013, showed that the cancer prevalence rate per

year was 5,000-7,000 among adults and 300-400 among children, with an increasing tendency for adults. Male: female ratios were 1:1.18 for adults and 1.46:1 for children²³. The WHO statistics from the global cancer observatory for 2018 showed a 5-year prevalence of 43 520 computed using sex, site- and age-specific incidence to 1-3- and 5-year prevalence ratios for the period (2000-2009), and scaled using Human Development Index (HDI) ratios. Breast cancer was the most common cancer with 5677 cases accounted for (36.6%) followed by Leukemia 1 808 (7%), Non-Hodgkin lymphoma 1 675 (6.5%) and Colorectal cancer 1 398 (5.4%) Oesophagus 1 132 (4.4%)²³. The percentage of women aged 30-49 years who have ever had a screening test for cervical cancer according to STEP 2016 was 1.7%²⁴.

Table 2: Prevalence of CVD, obesity/overweight, diabetes, cancers, and metabolic syndrome in Sudan

Prevalence of	Percentage (%)
Self-reported heart disease	2.5
Hypertension	20.4
Overweight	28.3
Obese	10
Urban Obese	17
Rural Obese	8.6
Impaired Fasting Glycaemia	3.4
Raised fasting blood glucose	6
The mean total blood raised cholesterol, including those currently on medication	13.8
CVD risk for aged 40-69 years with a 10-year $\geq 30\%$, or with existing CVD	3.5
5-year prevalence of cancer	43 520

Data source from SHHS Survey Second Round 2010⁹, Sudan WHO Stepwise report 2016²⁴, SAEED *et al.* 2020²³ and WHO Cervical cancer fact sheet for countries 2020²⁴.

5 Special focus on infant and children under 5 years

Sudan is a third-world country with high numbers of infants and children under five morbidity and mortality. Undernutrition is one of Sudan's most crucial, but least tackled health issues. Children's health suffers from a lack of population awareness about the outcomes of and solutions to undernutrition. According to the United Nations Children's Fund (UNICEF) reports in 2004 key demographic indicators under-five mortality rates in Sudan is 60.5 per 1000 live births, and the infant mortality rate is 42 per 1000 live births. However, UNICEF statistics have shown a dramatic decline in less than five mortality rates since the year 1990. The causes of death for children under five according to WHO are; pneumonia, prematurity, birth asphyxia, infections, congenital anomalies, diarrhea, injuries and others. Low birth weight rate is increasing in Sudan with prevalence of 31% according to UNICEF 2004 and this can cause adverse impact on both the short and the long term^{25,26}.

Children with low birth weight have a increased risk of perinatal mortality and morbidity. Furthermore, cognitive function, development, and growth are all affected, and there is an increased

risk to develop different chronic diseases later in life. Stunting is the impaired growth and development that children experience from poor nutrition, repeated infection, and inadequate psychosocial stimulation. Children are defined as stunted if their height-for-age is more than two standard deviations below the WHO Child Growth Standards median. In Sudan, the stunting of under-five prevalence is 38.2%, this is more than the average of the developing countries which is 25% Wasting which is low weight for height also has a higher prevalence in under-five in Sudan comparing it with the developing countries' average which are 16.8% and 8.9% respectively as of 2020 edition²⁷.

Under-nutrition is the main danger to children under-five in Sudan. Recently, Sudan have reported more malnourished children than 30 years ago, due to a rise in the prevalence in the past 20 years from 20 to 32 percent underweight, and from 32 to 35 percent according to UNICEF 2014 statistics. Communicable diseases constitute a significant reason for both morbidity and mortality in Sudan and the country continues to be susceptible to measles, meningitis, acute watery diarrhea and most recently chikungunya and dengue fever²⁶.

The newborn and child health indicators are still far away from reaching the goals for 2030. Forty percent of total child mortality is related to neonatal causes. The fact that 30 percent of the population in Sudan live more than 5 kilometers away from a primary health care service, causing the coverage with full primary health care service to be remarkably low, where only 24 percent of health institutes provide a comprehensive service of primary health care²⁶.

Table 3: Prevalence of low birth weight, stunting, wasting and underweight in Sudan

Prevalence of	Percentage (%)
Low birth weight	31
Stunting	38.2
wasting	16.8
Under-weight	35

Data source for this table from UNICEF 2004²⁵. Low birthweight: country, regional and global estimates and UNICEF/WHO/The World Bank Group joint child malnutrition estimates: levels and trends in child malnutrition: key findings of the 2020²⁶.

6 Exclusive breastfeeding practice versus early complementary feeding

The WHO recommends early initiation of exclusive breastfeeding up to six months and continuing breastfeeding plus complementary feeding up to two years. In countries with low-income and underused resources such as Sudan, children of two years and less are vulnerable to high morbidity and mortality^{27,28}. They are vulnerable to malnutrition, respiratory tract infections and otitis media. It was documented by a study conducted in 2015 that the high rates of malnutrition among children in Khartoum resulted from not being breastfed or from early weaning²⁹. Among the intervention methods, the WHO recommends exclusive breastfeeding to reduce neonatal mortality rates, in addition to prevent morbidities, on the other hand,

introducing early complementary feeding can be a direct cause of diseases as it exposes the infants to contamination from the utensils, water, or hands. This early complementary feeding can affect the infant's health by depriving them of the natural immunity in the breast milk causing gastrointestinal and respiratory infections. Furthermore, infants are at risk of developing food allergies, childhood cancer, cardiovascular diseases, diabetes and obesity later in life³⁰. It should be noticed that several factors have significant impact on delaying exclusive breastfeeding practice such as; pre-lacteal feeding, low socioeconomic status, the level of education and age of the mother at marriage, mother's occupation, the mode of delivery, the maturity and the size of infant, etc.³¹.

Table 4: Prevalence and Practices of Exclusive breastfeeding and early complementary feeding in Sudan

Age of Exclusive breastfeeding	Percentage of children (%)
0-1 month	25.6
2-3 months	18.5
4-5 months	6.0
<4 months	21.4
<6 months	15.6
Timely complementary feeding	
6-9 months	46.6
Continued breastfeeding	
12-15 months (1 year)	83.5
20-23 months (2 years)	40.4

Data source for this table from Sudan Central Bureau of Statistics Multiple indicator cluster Survey 2014³² and Abdel-Rahman 2020³⁴.

In 2014, according to the World Bank development indicators in Sudan the average of exclusive breastfeeding for under 6 months was 54.6 %. Optimal early feeding practice was delivered to 50% of Sudanese infants only, with recognizable diversity between different regions in the country. This is due to multiple factors related to socioeconomic status, and factors related to the mothers and children themselves. A national survey conducted in 2000, with the objective of describing the infant and young child feeding practices among infants under four months of age, revealed about a fifth of the infants were exclusively breastfed. The proportion decreased to 16% for infants under six months. Less than fifty percent received complementary food in addition to breastmilk was found in infant between 6 and 9 months³². In most cases, infants and young children receive complementary foods only once or twice a day. Basic cereal boiled in water or porridges with water of uncertain quality³³.

Eighty-four percent of the children approximately continued to be breastfed till the age of 12-15 months and 40% till age of 20-23 months³². The median duration of breastfeeding among children under three years, was 19 months in 1990. While breastfeeding is a fairly common practice in Sudan, progress still needs to be made to promote exclusive breastfeeding up to 6 months and to encourage timely supplementation of breast milk with nutritious food at 6-9 months³⁴.

7 Food insecurity

Food insecurity situation in Sudan has been the result of several inter-related factors which collectively resulted in what has been known as a "complex emergency". The key among these causes is the conflict and civil insecurity and the subsequent displacement of the population, climatic variability resulting in recurrent droughts and floods, inadequate investment in smallholder farming, inadequate rural infrastructure and weak rural markets³⁵. These causes in addition to limited access to basic public services, have resulted in more than three million people requiring humanitarian assistance every year. The national strategy for development excludes food security policy catalysts and fundamentally hinders the achievement of sustainable national food security. Thus, there is a need to streamline food security agendas in the country's development endeavors³⁶. Food insecurity combines with elevated food prices and worsening economic conditions resulted in high levels of vulnerability in Sudan, where approximately 6.2 million people in need of food security and livelihoods assistance and 3.3 million people in need of nutrition assistance, according to the country's Humanitarian Response Plan (HRP)³⁷. Overall, 13 million Sudanese were considered food to be food deprived in 2009. Malnutrition rates in children are also alarmingly high with half a million children suffering from Severe Acute Malnutrition (SAM) while close to two million are annually stunted. Sudan's Human Development Index is low (at 0.414 in 2012) and it ranks 171 out of 185 countries³⁸. Over 30 percent of food insecure people were concentrated in the Darfur region, Blue Nile, North Kordofan, Kassala and Gadarif also had high levels of food insecurity – between 13 and 19 percent of their population is in Crisis³⁹. The first nationally representative household consumption survey conducted in Sudan provides estimates for the various dimensions of poverty; it shows that the overall incidence of poverty in Northern Sudan is 46.5% and 26.5% urban poverty incidence rates. High regional disparity in poverty levels are evident as Northern Darfur (69.4%), Southern Kordofan(60%) , and Red Sea State (57.7%) are among the highest poverty-ridden areas and Kassala (36.3%), River Nile States (32.2%) and Khartoum (26%) have to lowest levels of poverty⁴⁰.

The main challenges to achieving food security include improvement of the nutrition status of the Sudanese population which is considered as a key component of the essential health care package with a special focus on maternal, child and at-risk populations in the national policies and strategies⁴¹. This entitles improving access to food by reducing poverty levels especially in rural areas where 57% of the population are estimated to be at to be under the poverty line⁴⁰. Although it is known that agriculture accounts for 31% of Sudan's total GDP and the centrality of agricultural activities to the livelihoods of over 40% of its population, the domestic supply, and stability of major staple grains (sorghum, millet and wheat) are insufficient in the face of a rapidly expanding population. To overcome this deficit,

coordination between areas of surplus and areas of grain deficit is greatly needed ⁴⁰.

Table 5: Food insecurity situation in Sudan

Food in Security Item	Number of population suffering (million)
Food deprived population	13
people in need of food security	6.2
people in need of nutrition assistance	3.3

Data source for this table from US AID FOOD ASSISTANCE FACT SHEET – SUDAN 2020 ³⁷ and SHHS Nutritional area 2010 ⁹.

8 Conclusion

Malnutrition is a major issue in Sudan, although the dietary intake contributions to total energy were in line with the guidelines. The increased prevalence rates are due to the lack of proper quality and quantity of food, low socioeconomic status and the lack of knowledge on feeding practices. There are other factors such as the limited access to resources which are compounded with conflicts in many parts of the country augmented by climatic drought and floods and, poor infrastructure, infectious diseases which are considered a major health problem across the country.

There is clear evidence that micronutrient deficiencies are a major public health issue and they are widespread with dangerous health consequences, although recent survey data are lacking. The non-communicable disease statistics in Sudan was not comprehensive, especially in cancer registry and surveys. Sudan is still struggling with high numbers of infants and children under five morbidity and mortality which are still far away from reaching the goals for 2030.

Notwithstanding these challenges, the government and the Federal Ministry of Health, move along to make progress towards nutrition and food security, some supplementation campaigns have been conducted but coverage of the population is still low.

9 Recommendations

One of the priorities for the Federal Government of Sudan should be improving the health and nutrition status. Stopping tribes' conflicts, improving infrastructures, transport, and raising of health awareness should take priority in the government agendas in order to combat the adverse effects of malnutrition, micronutrients deficiencies, communicable and non-communicable diseases. Health intervention, in terms of health education, leading to modifying behaviors, and that can be achieved through efficient collaboration with the governmental and nongovernmental agencies to enhance children's health status are still required.

Health education about breastfeeding promotion should also be improved. Encouraging the working mothers to breastfeed according to the WHO/UNICEF guidelines and providing appropriate facilities in the workplaces. Most of the national

hospitals that take care of mothers and babies should adopt the baby Friendly Hospital Initiative. Starting to teach future mothers from an early age about correct breastfeeding and complementary feeding practices and their importance, should be in the schools and at the community level.

In addition to Improving health services to ensure availability and accessibility of primary and essential health care for all citizens to reach the goal of health for all and ensure equality mainly through focusing on vulnerable groups.

The limitations of the current review depend solely on secondary data which might provide incomplete information, in addition to some references were old due to limited access of the whole range of data.

Author contribution: All authors approved the final version before submission, have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Conflict of interest: The authors declare no conflicts of interest.

ORCID

Howeida ABUSALIH: <https://orcid.org/0000-0003-3530-1519>

Zeinab ABU SABEL: <https://orcid.org/0000-0002-2358-2010>

References

1. Central intelligence Agency (CIA). The world fact book one page county summary of Sudan. Accessed April 2020. Available at URL: <https://www.cia.gov/library/publications/resources/the-world-factbook/attachments/summaries/SU-summary.pdf>
2. Central Bureau of Statistics (Sudan), Food and Agriculture Organization of the United Nations (FAO), Statistics. Sudan - North National Baseline Household Survey (NBHS) 2009. Khartoum, Sudan. Available at : <http://ghdx.healthdata.org/record/sudan-north-national-baseline-household-survey-nbhs-2009>
3. WHO country health profile of Sudan provides key statistics, information, news, features and journal articles on the country's public health issues and services 2020. Available at: <https://www.who.int/countries/sdn>
4. Sullivan, P.J., & Nasrallah, N., (2010). Improving Natural Resource Management in Sudan: A Strategy for Effective State Building and Conflict Resolution. US Institute of Peace, 2010. Available at: www.jstor.org/stable/resrep12375.
5. United Nation Developmental Program About Sudan (2020). Accessed July 2020. Available at URL: <https://www.sd.undp.org/content/sudan/en/home/countryinfo.html>
6. FMOH (Federal Ministry of Health) Sudan. 5-year Health Sector Strategy: Investing in Health and Achieving the MDGs 2007-2011. Specifications and Standards for Health System in Sudan 2010. pp101. Available at: <http://extwprlegs1.fao.org/docs/pdf/sud174887E.pdf>

7. Sudan – Scaling up Nutrition SUN 2020. Accessed July 2020. Available at: <https://scalingupnutrition.org/sun-countries/sudan/>
8. Beal, T., Massiot, E., Arsenault, J. E., Smith, M. R., & Hijmans, R. J. Global trends in dietary micronutrient supplies and estimated prevalence of inadequate intakes. *PLoS ONE* 2017.12(4): e0175554. <https://doi.org/10.1371/journal.pone.0175554>
9. Sudan Household and Health Survey Second Round 2010: Summary Report - Sudan. (2020). Accessed July 2020. Available at: <https://reliefweb.int/report/sudan/sudan-household-and-health-survey-second-round-2010-summary-report>
10. Sudan Central Bureau of Statistics. (2011). Food and Nutrition Security Assessment in Sudan: Analysis of 2009 National Baseline Household Survey. Available at: http://www.fao.org/fileadmin/user_upload/emergencies/docs/SudanFoodInsecurityAssessment_July10.pdf
11. Food Agricultural Organization (2003). Methodology for the measurement of food deprivation. Statistics Division, Food Security Statistics. Rome. Available at: <http://www.fao.org/economic/ess/ess-fs/en/>
12. World Food Programme (WFP). Emergency Food Security and Nutrition Assessment in Darfur, Sudan 2005. Provisional Report Khartoum and Khartoum, World Food Programme. 2005. Available at : <https://documents.wfp.org/stellent/groups/public/documents/rereports/wfp117335.pdf>
13. Adam, I., Ibrahim, Y., & Elhardello, O. (2018). Prevalence, types and determinants of anemia among pregnant women in Sudan: A systematic review and meta-analysis. *BMC Hematology* 18(31). <https://doi.org/10.1186/s12878-018-0124-1>
14. WHO (2000). Global Database on Vitamin A Deficiency . The Vitamin A Deficiency database includes data by country based on xerophthalmia and/or serum or plasma retinol concentration. Updated 07.12.2007 Available at: https://www.who.int/vmnis/vitamina/data/database/countries/sdn_vita.pdf?ua=1
15. Husain, N. E., Suliman, A. A. B., Abdelrahman, I., Bedri, S. A., Musa, R. M., Osman, H.E., Mustafa A. H, Gafer N., Farah E., Satir A. A., Ahmed M. H., Osman M., Khalil A. A., & Agaimy A. (2019). Vitamin D level and its determinants among Sudanese Women: Does it matter in a sunshine African Country? *Journal of Family Medicine and Primary Care*, 8(7):2389. https://doi.org/10.4103/jfmpc.jfmpc_247_19
16. Jurowski, K., Szewczyk, B., Nowak, G., & Piekoszewski, W. (2014). Biological consequences of zinc deficiency in the pathomechanisms of selected diseases. *Journal of Biological Inorganic Chemistry*, 19(7):1069-1079. <https://doi.org/10.1007/s00775-014-1139-0>
17. Prasad, A. S. (2013) Discovery of human zinc deficiency: its impact on human health and disease. *Advances in Nutrition*, 4(2):176-190. <https://doi.org/10.3945/an.112.003210>
18. Abass, R. M., Hamdan, H. Z., Elhassan, E. M., Hamdan, S.Z., Ali, N. I., & Adam, I. (2014) Zinc and copper levels in low birth weight deliveries in Medani Hospital, Sudan. *BMC Research Notes*, 7(1):386. <https://doi.org/10.1186/1756-0500-7-386>
19. Zimmermann, M. B., Wegmueller, R., Zeder, C., Chaouki, N., Biebinger, R., Hurrell, R. F., & Windhab E. (2004). Triple fortification of salt with microcapsules of iodine, iron, and vitamin A. *The American Journal of Clinical Nutrition*, 80(5):1283-1290. <https://doi.org/10.1093/ajcn/80.5.1283>
20. Ministry of Health, Directorate General Primary Health Care, National Nutrition Department. IDD baseline survey report. Khartoum: Ministry of Health. 1999.
21. Ministry of Health, Directorate General of Public health and Emergency. Non-communicable Disease National Strategic Plan 2010-2015. Available at: https://www.iccp-portal.org/system/files/plans/SDN_B3_Sudan%20NCD%20strategy.pdf
22. WHO. 2020 Non-communicable diseases and their risk factors. STEP wise approach to surveillance (STEPS). Available at: <http://www.who.int/chp/steps/en/>
23. Saeed, M.E., Cao, J., Fadul, B., Kadioglu, O., Khalid, H.E., Yassin, Z., Mustafa, S.M., Saeed, E., & Efferth, T. (2016). A Five-year Survey of Cancer Prevalence in Sudan. *Anticancer Res*, Jan;36(1):279-86. PMID: 26722054.
24. WHO 2020. Cervical cancer data. Available at: <https://gco.iarc.fr/today/data/factsheets/populations/729-sudan-fact-sheets.pdf>
25. UNICEF and WHO 2004. Low birthweight: country, regional and global estimates. ISBN: 92-806-3832-7. Available at : https://www.unicef.org/publications/files/low_birthweight_from_EY.pdf
26. UNICEF/WHO/The World Bank Group joint child malnutrition estimates: levels and trends in child malnutrition: key findings of the 2020 edition. 2020. Available at: <https://www.who.int/publications/i/item/jme-2020-edition>
27. UNICEF. Nutrition's lifelong impact. 2018. Available at : https://www.unicef.org/nutrition/index_lifelong-impact.html
28. Kanan S.O.H., & Swar M.O. (2016). Prevalence and outcome of severe malnutrition in children less than five-year-old in Omdurman Paediatric Hospital, Sudan. *Sudanese Journal of Paediatrics*, 16(1):23. PMID: PMC5025929
29. Ibrahim, A. M. M., Alshiek, M.A.H., Ngoma, M. S., & Adam D. (2015). Breastfeeding among Infants and Its Association with the Nutritional Status of Children Under Five Years in Khartoum, Sudan. *International Journal of Healthcare Sciences*, 3 (1): 177-184.
30. Victora, C. G., Bahl, R., Barros, A. J., França, G. V., Horton, S., Krasevec, J., Murch, S., Sankar, M. J., Walker, N., Rollins, N. C., & Lancet Breastfeeding Series Group. (2016). Breastfeeding in the 21st century: epidemiology, mechanisms,

- and lifelong effect. *The Lancet*, 387(10017):475-490. [https://doi.org/10.1016/s0140-6736\(15\)01024-7](https://doi.org/10.1016/s0140-6736(15)01024-7)
31. Hassan, A.A., Taha, Z., Ahmed, M. A. A., Ali A. A. A., & Adam, I. (2018). Assessment of initiation of breastfeeding practice in Kassala, Eastern Sudan: a community-based study. *International Breastfeeding Journal*, 13(34). <https://doi.org/10.1186/s13006-018-0177-6>
 32. Ministry of Cabinet Central Bureau of Statistics US. Multiple indicator cluster Survey 2014 of Sudan, final report. 2016. Available at: <https://mics.unicef.org/files?job=W1siZiIsIjIwMTYvMDUvMTgyMjEvNTkvNTEvODg3LlN1ZGFuXzIwMTRFTUIDU19FbmdsaXNoLnBkZjIjXQ&sha=32907fc39e6e2e6e>
 33. McGrath, M., (2007) Working Together in Emergencies: Infant and Young Child Feeding in Emergencies. *SCN News*, 34:37-42. Available at : <https://www.enonline.net/attachments/185/ife-working-together-scn-2007.doc>
 34. Abdel-Rahman, M.E., El-Heneidy, A., Benova, L. & Oakley L. (2020). Early feeding practices and associated factors in Sudan: a cross-sectional analysis from multiple Indicator cluster survey. *International Breastfeeding Journal*, 15 (41). <https://doi.org/10.1186/s13006-020-00288-7>
 35. FAO / WHO Second International Conference on Nutrition. (2014) ICN2 Sudan National Nutrition Strategy Paper. Available at: http://scalingupnutrition.org/wp-content/uploads/2016/08/3.-Sudan-Nutrition-strategic-apaer-ICN_2.pdf
 36. FAO. (2010). Common features of countries in protracted crisis: What are they and why do they deserve special attention? *The State of Food Insecurity in the World (2010)*. 12-26. Available at: <http://www.fao.org/3/i1683e/i1683e03.pdf>
 37. US AID Food Assistance Fact Sheet – Sudan. (2020) Available at: <https://www.usaid.gov/sudan/food-assistance>
 38. World Health Organization, Food and Agriculture Organization of the United Nations, National Nutrition Strategy Paper for Sudan. Second International Conference on Nutrition Rome, 2016. Available at: http://scalingupnutrition.org/wp-content/uploads/2016/08/3.-Sudan-Nutrition-strategic-apaer-ICN_2.pdf
 39. The Famine Early Warning Systems Network (FEWS NET). Food Security Outlook. June 2020 to January 2021. Available at: <https://fewsn.net/east-africa/sudan/food-security-outlook/june-2020>
 40. National Bureau of Statistics (NBS). The National Baseline Household Survey 2009 Report for South Sudan. Available at: <https://reliefweb.int/sites/reliefweb.int/files/resources/NBHS%20Final%20website.pdf>
 41. Federal Ministry of Health (FMOH). National Nutrition Strategic Plan 2014-2025 (2014). Available at: https://scalingupnutrition.org/wp-content/uploads/2016/08/4.-Sudan-National_nutrition_strategic_Plan.pdf

Cite this article as: Abusalih, H., & Abu Sabeib, Z. (2020) Update of the nutritional situation in the Republic of the Sudan. *The North African Journal of Food and Nutrition Research*, 4(9): S17-S24. <https://doi.org/10.51745/najfnr.4.9.S17-S24>

© 2020 The Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.